ROCK BREAKING CARTRIDGE AND USE THEREOF

BACKGROUND OF THE INVENTION

[0001] This invention relates generally to the breaking of rock.

[0002] As used herein the word "rock" includes rock, ore, coal, concrete and any similar hard mass, whether above ground or underground, which is difficult to break or fracture. It is to be understood that "rock" is to be interpreted broadly.

[0003] A number of techniques have been developed for the breaking of rock using non-explosive means. Most non-explosive rock breaking techniques rely on the generation of high gas pressures to initiate a tensile fracture in rock at the bottom or sides of a relatively short drill hole. Efficient confinement of the gas, produced in the hole, is a prerequisite for ensuring that the available energy is effectively used to break the rock. In order to confine the gas it is known to make use of stemming, of any appropriate type.

[0004] The propellant which is ignited to generate the required gas pressures is normally provided in a cartridge. The placement of the cartridge in a hole and the positioning of suitable stemming thereafter can be time-consuming and the person doing the work can, as a consequence, be exposed to a dangerous or hostile environment for a relatively long time.

SUMMARY OF INVENTION

[0005] The invention provides a method of using a rock breaking cartridge which includes the steps of placing the cartridge in a hole in a body of rock and activating a stemming device which is in or on the cartridge.

[0006] The step of activating the stemming device may cause the cartridge to be engaged with a wall of the hole.

[0007] The cartridge may include a tubular body and at least a portion of the tubular body may be frictionally engaged with the wall of the hole when the stemming device is activated.

[0008] The stemming device may be activated on one side by the manual application of pressure or force or movement. When a propellant inside the cartridge is ignited the stemming device may, as a result of pressure which is generated inside the tubular body, be activated from a second opposing side.

[0009] Although the stemming device may be positioned in or on a component which is attached to the tubular body it is preferred to position the stemming device inside the tubular body.

[0010] The method may include the step of weakening the tubular body to facilitate expansion thereof by the stemming device. The tubular body may for example be formed with one or more slots.

[0011] The invention also extends to a rock breaking cartridge which includes a tubular body, propellant inside the tubular body, and a stemming device in or on the tubular body.

[0012] The stemming device may comprise, at least partly, a device which is known in the art. However, an important aspect of the invention lies in the incorporation of the stemming device in the cartridge.

[0013] The propellant may be located in an enclosure which is inside the tubular body and the stemming device may be separated from the enclosure at least by suitable filler.

[0014] In a variation of the invention the stemming device is formed by a cap, inside the tubular body, which confines the propellant, and by a component, also inside the tubular body, with the cap and component having relatively inclined mating surfaces which are relatively movable thereby to cause a portion of the tubular body to expand radially.

[0015] The filler may be positioned inside the tubular body between the stemming device and the enclosure.

[0016] In a preferred form of the invention the rock breaking cartridge includes a tubular body, an enclosure which is defined inside the tubular body by means of first and second caps which are positioned in a bore of the tubular body, a propellant inside the enclosure, a stemming device which is positioned inside the tubular body and which, upon activation, expands a portion of the tubular body in a radial sense, the stemming device being spaced from the enclosure, and a filler inside the tubular body between the enclosure and the stemming device.

[0017] The enclosure may be formed by the inner and outer caps and the stemming device may be closer to the inner cap and spaced therefrom. The inner cap may be wedge-shaped or conical.

[0018] The filler may be positioned between the inner cap and the stemming device and may be of any appropriate kind eg. a particulate material such as sand.

[0019] The stemming device may be of any suitable type and may comprise an appropriate device which is known in the art. For example the stemming device may include wedges or components with relatively inclined surfaces which are relatively movable thereby to cause a portion of the tubular body in which the stemming device is located to expand radially.

[0020] The tubular body may be weakened to facilitate expansion thereof by the stemming device.

[0021] The weakening may be done in any appropriate way and for example zones of weakness may be formed in portions of the tubular body at defined locations.

[0022] The zones of weakness may be defined by grooves or similar formations in the tubular body but preferably the tubular body is split at least along one line in a longitudinal sense thereby to define at least one portion of the tubular body which is readily expansible in a radial sense upon activation of the stemming device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The invention is further described by way of examples with reference to the accompanying drawings in which:

Figure 1 illustrates a stemming device for use in a rock breaking cartridge according to a first form of the invention;

Figure 2 shows a rock breaking cartridge which includes the stemming device of Figure 1, located in a hole in a rock face;

Figures 3 and 4 are views corresponding to Figures 1 and 2 respectively and show a different rock breaking cartridge which makes use of a second type of stemming device; and

Figure 5 illustrates how a tubular body used in the rock breaking cartridge of the invention is weakened to facilitate its expansion by a stemming device.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0024] Figure 2 of the accompanying drawings illustrates a rock breaking cartridge 10 according to a first form of the invention which includes an elongate tubular body 12, inner and outer caps 14 and 16 which are located inside a bore 18 of the body, a propellant 20 which is located inside an enclosure 22 defined in the bore 18 between the inner and outer caps, a stemming device 30 which is partly positioned inside the bore 18 at an end of the body opposing the cap 16, and a filler 34 which is positioned inside the body between the inner cap 14 and the stemming device 30.

[0025] As used herein "propellant" is to be interpreted broadly to include any energetic substance such as a propellant, blasting agent, explosive, gas-evolving substance, or similar means which, once initiated, generates high pressure material typically in gaseous form. "Propellant" does not include a high explosive.

[0026] An igniter 36, of known construction, is positioned inside the propellant 20. An igniter lead wire 40 extends from the propellant through a hole 41 in the inner cap

and along a groove 42 in an outer surface of the stemming device. A portion 44 of the wire is therefore positioned externally of the tubular body.

[0027] The tubular body is made from any appropriate material such as, for example, a high density plastics material eg. in an extrusion process. The caps 14 and 16 are made from a similar material for example by using injection moulding techniques.

[0028] The filler 34 is a particulate material with a high friction capability eg. graded sand with an appropriate aggregate or particle size.

[0029] The stemming device 30 is shown in further detail in Figure 1. The stemming device is made from wood or a suitable plastics material and includes two wedge components 46 and 48 respectively which have mating sloping faces 50 and 52 respectively. When the wedge components are engaged with each other as is shown in Figure 2 they form a substantially cylindrical body which is pressed into position inside the bore 18 of the body with a relatively close fit. The wedge component 48 is formed with the groove 42 in its external surface.

[0030] The inner cap 14 is formed with a wedge or conical outer surface 56.

[0031] Figure 5 is a perspective view of an end portion 58 of the tubular body in which the stemming device 30 is positioned. This portion is weakened by means of a longitudinally extending slot 60 which is cut through a wall of the body for a length which is more or less the same as the length of the stemming device and by a second slot 62 which is cut circumferentially into the body at one end of the slot 60 over approximately half of the circumference of the body.

[0032] Figure 2 shows the cartridge 10 positioned in a hole 64 formed in a rock face 66. Once the cartridge is correctly positioned the stemming device 30 is activated, for example by means of a hammer blow on a large face 68 which is presented (in this example) by the wedge component 46. In so doing the wedge component is driven into the bore 18 with the faces 50 and 52 riding over each other. This exerts a radial expansion force on the portion 58 which, due to the weakening effect of the slots 60 and 62, thereupon expands radially outwardly with relative ease. The cartridge is thereby locked in position with the expanded portion of the tubular body being frictionally engaged with the wall of the hole.

[0033] The igniter 36 is ignited in any appropriate way via the igniter lead wire 40 using techniques which are known in the art and which, for this reason, are not further described herein. Ignition of the propellant results in the generation of high pressure jet material, substantially in gaseous form, in the enclosure 22. Substantial forces are generated inside the enclosure and the body is radially expanded. Forces are exerted on the caps 14 and 16 which tend to move the caps axially away from each other. The cap 14 is thereby moved deeper into the filler 34 and the filler, which is a particulate material with a high friction capability, tends to flow towards and against the stemming device. A force is thereby exerted, particularly on a large face 70 of the wedge component 48 which faces the filler, which increases the wedging action of the stemming device. The effectiveness of the stemming device is thereby enhanced by the action of the propellant.

[0034] The twin activation of the stemming device, ie. when the stemming device is initially manually activated and as a result of the ignition of the propellant, means that a highly effective stemming action results.

[0035] The groove 42 allows the igniter lead wire 40 to pass to a location outside the bore 18 and is such that, when the stemming device 30 is activated, no damage is caused to the igniter lead wire.

[0036] Figures 3 and 4 illustrate a rock breaking cartridge 10A according to a second form of the invention. The cartridge 10A is substantially the same as the cartridge 10 except that the stemming device 30 is replaced by a stemming device 30A. Where applicable like reference numerals are used to designate like components and the following description is largely confined to points of difference between the two stemming devices.

[0037] The stemming device 30A includes two wedge-shaped components 46A and 48A respectively which present inclined surfaces 50A and 52A to each other which define a wedge-shaped cavity 74 between them. A wedge-shaped barrel 76 is positioned in the cavity and a threaded shank 78 is engaged with a threaded passage 80 in the barrel.

[0038] Viewed from one end the wedge components 46A and 48A, when engaged with each other as is shown in Figure 3, present an outer surface which has a circular profile and which is slightly less in diameter than the diameter of the hole 64 in the rock face 66.

[0039] A washer 82 is fixed to a protruding end 84 of the shank which is provided with a lever-type formation 86 which facilitates rotation of the shank.

[0040] The stemming device 30A is engaged with the tubular body 12 of the cartridge as shown in Figure 4. As is the case with the cartridge 10 shown in Figure 2 an end portion of the tubular body is weakened in the manner shown in Figure 5.

[0041] Once the cartridge 10A has been positioned in the hole 64 in the rock face the lever formation 86 is rotated in a direction which causes the wedge-shaped barrel 76 to be drawn deeper into the cavity 74. The wedge components 46A and 48A are thereby forced apart and the tubular body is frictionally locked in position in the hole 64. Once the propellant 20 is ignited, pressure exerted by gas, which is evolved by the propellant, drives the inner cap 14 into the particulate filler which is thereby forced into the cavity 74 in the stemming device. The components 46A and 48A are urged radially apart with the result that the effectiveness of the stemming device is enhanced.

[0042] In a variation of the invention the filler is not used. Referring to Figure 2 the cap 14 does not have the conical surface 56 and an outer surface of its leading end is similar to the wedge component 48. The wedge component 46 then acts directly on the cap, not via the medium of a filler. In other respects the cartridge functions generally in a manner similar to what has been described hereinbefore.

[0043] The stemming device, in each embodiment of the invention, acts to help contain gas, released by the ignited propellant, within the hole in the rock face. The high pressure of the gas is effectively contained in the hole 64. The tubular body initially expands plastically confining the high pressure material which is released by the propellant and a substantial force is thereby generated inside the body. As the body fractures the energy which is released results in localised fracture of the rock in one or more regions adjacent the body.

[0044] The invention thus provides a rock breaking cartridge which includes an integral internal stemming device which may be of any appropriate design. The cartridge is inserted in a single operation into a hole in a rock face and it is not

necessary for a separate stemming device or filler to be placed in the hole after the cartridge has been positioned. These steps are carried out in one operation. The use of the cartridge of the invention thus saves time and increases safety because the period of time required for a person to install the cartridge is reduced.

[0045] The rock breaking cartridge of the invention also allows for use to be made of robotic applications for the insertion process is relatively simple compared to conventional techniques which require the cartridge to be placed and then for stemming to be inserted into a hole in separate operations.